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The BE-TEC NSF S-STEM Program: Advancing Retention and Excellence in Computer Science and Engineering Education

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Abstract

Utah Valley University (UVU) was awarded an NSF S-STEM grant for $1.5 million dollars (over a six-years period) to strengthen outcomes for students in computer science and engineering through Leadership, Engagement, Academic Mentoring, and Preparation. This BE-TEC (Building Exceptional Talent in Engineering and Technology) scholarship program is a dynamic Track 2 scholarship program for students in Electrical Engineering, Computer Engineering, Computer Science, Computational Data Science, Software Development, and Software Engineering. This paper presents the objectives, structure, and outcomes of the NSF BE-TEC program, highlighting its measurable impact on student success indicators such as GPA improvement, retention rates, graduation rates, and post-graduation employment or graduate study. The findings demonstrate that combining financial support with intentional mentoring, engagement, and experiential learning can significantly improve student performance and persistence in computing and engineering disciplines. Lessons learned from this initiative can inform and guide similar programs nationwide in developing effective, scalable models for supporting STEM students.

Introduction

The National Science Foundation (NSF) established the Scholarships in STEM (S-STEM) program in accordance with the American Competitiveness and Workforce Improvement Act of 1998, to address the national need to increase the number of American scientists and engineers [1]. S-STEM programs award scholarships to academically talented students who demonstrate financial need. S-STEM programs are designed to increase the number and diversity of students entering science and engineering programs as well as to retain more students in their STEM programs through graduation and to improve the quality and preparedness of graduates entering the science and engineering workforce.

The Smith College of Engineering and Technology at Utah Valley University (UVU) was granted an S-STEM Track 2 scholarship program for students in Electrical Engineering, Computer Engineering, Computer Science, Computational Data Science, and Software Engineering. This program is advancing Utah's Engineering and Computer Science Initiative, contributing to a high-quality STEM workforce, and strengthening programs at a large, open-admissions university. The BE-TEC scholarship program is building on the success of a previous S-STEM Track 1 program [2] by:

1) promoting student success and degree completion through scholarships to low-income, academically promising students, beginning in their freshman year.
2) implementing evidence-based activities to support scholars including intentional faculty mentoring, high impact practices, and professional preparation.

3) advancing knowledge about evidence-based, context-specific interventions for STEM programs at primarily undergraduate institutions. BE-TEC is increasing support of financially needy students with an interest and aptitude for engineering and computing degree programs by offering an average of 23 scholarships per year over a six-year period to at least 43 unique students.

This project, now in its fifth year, is increasing the graduation rate for students in Computer Science and Engineering at UVU, an open enrollment university, and better preparing them for continued education and/or success in the STEM workforce by providing scholarships to academically talented students with financial need and by providing leadership opportunities, engaged learning activities, and mentoring. Up to now, fifty-five students meeting the selection criteria have been recruited and awarded scholarships.

Background Information

Utah Valley University (UVU) is a large regional institution serving over 46,000 students in Utah County, the state's second-largest county. Utah County has been one of the fastest growing regions in the country with more than 96% growth between 1990 and 2010-time period [3]. Because of this huge growth, UVU has undergone multiple transitions since its origin in 1941 and has expanded its mission and role within the region. In 1987, it was a community college. The institution became a state college in 1993 and a regional university in 2008. In fall 1993, the enrollment was 10,500 and tripled in fall 2012 to 31,500. The demand for education has been met by an increase in baccalaureate degrees offered from three in 1995 to 91in 2020 in addition to eleven master programs as well as 65 associate degrees. This required institutional transition has strained state and community resources and created several challenges, particularly in the availability of scholarship funds. UVU is regionally accredited by the Northwest Commission on Colleges and Universities. The university has a dual mission: it offers 110 bachelor's degrees and 20 master's degrees as a comprehensive university, and it also provides 65 associate degrees and 96 certificate programs as a community college. To fulfill its community college mission, UVU maintains an open-enrollment policy. The university serves a diverse student body, with 38% of students being low-income and 41% being first-generation. Additionally, UVU has a significant population of non-traditional students, including 29% who are older than the typical college age, 35% with spouses [4], and 19% with children under age 12 [5]. Despite relatively low tuition, 36% of degree-seeking students attend part-time. These factors contribute to the university's overall graduation rate of 33% (as measured by the national IPEDS standard for completions in 150% of normal time) and a 70% one-year retention rate for baccalaureate degree-seeking students. About 80% of UVU's students will remain in their communities and pursue employment in this region [6, 7].

Computer Science and Engineering Departments

To meet one of the region's most pressing workforce needs, UVU initiated three new engineering programs in Fall 2018. The new bachelor's degree programs in Electrical Engineering, Civil Engineering, and Mechanical Engineering have joined UVU's established programs in Computer Engineering and Pre-Engineering in a new Department of Engineering. The new programs were immediately popular with students, with 300 students enrolling for Fall

2018. Before forming the Engineering Department at UVU, Computer Engineering program was housed in the Computer Science department which offers a Bachelor of Science (BS) in Computer Science, Software Engineering, and Computational Data Science. It also offers a Bachelor of Applied Science in Software Development and a Master of Computer Science. The Bachelor of Science in Computer Science program was one of the first Bachelor of Science programs implemented at UVU in 1993. The program's goal has been to provide a quality program that meets accreditation standards while providing the students with a skill set that allows them to succeed in computing careers. The Computer Science degree at UVU is accredited by Computing Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). Currently, the Computer Science Department has 988 students.

In Fall 2024, the engineering department was reorganized into two: Mechanical and Civil Engineering (MCE), and Electrical and Computer Engineering (ECE). The ECE Department now serves about 300 students and offers ABET-accredited programs in Electrical and Computer Engineering.

Tables 1 and 2 show the enrollment and graduation trends in the Computer Science and Engineering programs. As can be seen from the tables, the number of students has continued to rise over the past eight years for most of the programs, however, the graduation rate remains low. Many students, particularly juniors and seniors, work over 20 hours a week to support their families while attending school, thus slowing down their progress and delaying their graduation. Most of our students are married and have several children. These students often leave their programs of study early to accept employment in an industry anxious for employees. The Utah Department of Workforce job forecasts and other job trends surveys indicate that while these students can earn strong salaries without degrees, their careers will not advance as they would with degrees [8]. Employers are also feeling the disadvantage of too few job candidates with adequate training provided by a baccalaureate degree [9]. The lack of adequate number of scholarships in Computer Science and Engineering programs is a significant inhibitor in graduating and enrolling more students.

Enrollment Numbers								
Program	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023 - 2024	2024-2025
Computer Science	1352	1385	1343	1,288	1,283	1,185	1,264	988
Computer Engineering	283	265	209	199	176	152	104	110
Software Engineering	206	233	230	280	271	292	251	174
Electrical Engineering	-	74	127	142	186	190	166	188

Table 1: Enrollment Numbers in Computer Science and Engineering Departments

Graduation Numbers								
Program	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023 - 2024	2024 - 2025
Computer Science	64	92	115	129	105	122	97	144
Computer Engineering	13	8	20	15	14	4	9	12
Software Engineering	12	23	15	22	24	23	32	48
Electrical Engineering	-	-	2	3	7	11	11	15

Table 2: Graduation Numbers in Computer Science and Engineering Departments

BE-TEC Project Goal and Objectives

The goal of the BE-TEC project is to build on the success of a previous S-STEM program to increase the graduation and retention rates for students in Engineering and Computing at UVU and develop their potential for success in the STEM workforce by providing scholarships to academically talented students with financial need and by providing evidenced-based support and activities to include intentional faculty mentoring, engagement in high-impact practices, professional preparation, and leadership opportunities [2].

The Process objectives of the BE-TEC project are to:

1. **"Scholarship Awards** - Increase support of financially needy, but academically talented students (including students from underrepresented groups) with an interest and aptitude for engineering and computing degree programs by offering an average of 23 scholarships per year over a 6-year period to at least 43 unique students.

2. **Intentional Mentoring** - Support scholars' academic growth with faculty mentors who emphasize the use of an Individual Education and Development Plan to foster student growth and increase student outcomes for persistence, completion, and career aspirations.

3. **Engagement in High Impact Practices** - Engage scholars in high impact practices, including capstone projects, internships, and collaborative projects.

4. **Professional Preparation** - Foster professional preparation through common academic coursework, skills workshops, guest speakers and career awareness presentations, field trips to industry, and conference participation and presentation.

5. **Leadership Opportunities** - Provide leadership opportunities for all scholars within a student section of a professional organization (IEEE) or club (BE-TEC Club)". [2]

The Measurable Outcome Objectives of the BE-TEC project is:

A. **"Graduation** - A minimum of 20 scholarship recipients will graduate with a baccalaureate degree in EE, CE, CS, or SE by the end of year six. (18 will still be enrolled)
B. **Completion and year-to-year persistence rates of BE-TEC participants** will show an increase from the departmental baseline and a comparison cohort.

C. **Employment in STEM Workforce** - A minimum of 95% of BS degree graduates will be employed in a STEM field or enrolled in graduate school within in 6 months after graduation.
D. **Advance Knowledge** about the use of internships to learn relevant job skills, increase social and communication skills, and improve employment outcomes (salary & jobs in field). Two papers on the results of the program will be submitted and presented at conferences". [2]

BE-TEC Program Management Plan

As part of the BE-TEC grant application to the NSF, UVU developed a project management plan for the BE-TEC S-STEM scholarship program. Specifically, the PI has overall administrative responsibility for the project and for interacting with NSF. She coordinates the activities of the Project Management Team, including activities such as advertising and recruitment of students, selection of students, maintenance of BE-TEC records, and oversight of student support services. She has fiscal oversight and reporting responsibilities for the project. Co-PI's were responsible for conducting selection of scholarship recipients, ensuring that recipients understood their obligations to the program, assigning mentors, meeting with students regularly, and monitoring their progress [2].

BE-TEC Scholar Selection Criteria

Students were selected based on the following criteria:

1) U.S. Citizen, Permanent Resident, US nationals, or admitted refugee.
2) Demonstration of low-income (defined at UVU as Pell Eligible); and have unmet financial need in accordance with the Department of Education FAFSA rules.
3) Demonstrate academic ability or potential.
4) Full-time student majoring in Computer Science, Computer Engineering, Software Engineering, Electrical Engineering, or Computational Data Science.

BE-TEC Scholar Agreement

The selected BE-TEC Scholars were committed to progressing in their major by signing a contract with the institution. This contract sets out their requirements to accomplish the following:

1) Maintain a grade point average of at least 3.0 in all classes taken.
2) Meet with their faculty mentor twice per semester (monthly for the first year) and create an Individual Education and Development Plan (IEDP).
3) Participate in common coursework to the extent possible
4) Attend the initial meeting and two monthly BE-TEC meetings each semester.
5) Participate in the IEEE student section or CE club (participants will be urged to accept leadership roles)
6) Complete an internship course in their junior or senior year.
7) Scholars will also agree to participate in ongoing project evaluation.

Scholars required out-of-class time commitments are not going to be extensive and focus on the most important activities for program coherence and student success. The most important element of the scholar contract is academic performance. Thus, there are some options and flexibility to allow the BE-TEC scholars with other responsibilities to reasonably participate in the activities.

High Impact Practices in NSF BE-TEC Program

High-impact practices (HIPs) are specific active learning practices that educational research has shown to increase rates of student retention and higher levels of learning success [12]. HIPs are innovative and transformational learning opportunities for students inside and outside of the classroom that provide a variety of learning benefits aimed at promoting the success of students. Student success is the core objective of any institution of higher education. There are ten types of high-impact practices endorsed by the Association of American College and Universities (AAC&U) and George Kuh. In an AAC&U report, Kuh describes a strong positive effect of participating in high-impact activities as measured by the National Survey of Student Engagement (NSSE) [10]. Kuh identified the following ten learning experiences as high -impact educational practices which research has shown benefit students of many backgrounds [14]:

- First Year Seminars and Experiences
- Common Intellectual Experiences
- Learning Communities
- Writing-Intensive Courses
- Collaborative Assignments and Projects
- Undergraduate Research
- Diversity/Global Learning
- Service Learning, Community-Based Learning
- Internships
- Capstone Courses and Projects.

Kuh recommends that to increase student engagement and student success, every student should participate in at least two HIPs during their academic career, but ideally every student should participate in one HIP each year in college. While not all HIPs address each element to the same degree, the list provides a standard for judging the quality of implementation. It could potentially be used to assess the quality of other evidence-based curricular and co-curricular activities as well.

The most common outcome studied across all high-impact practices is student retention and academic performance (grade point average). For both measures the result is positive: students who participate in HIPs are consistently retained in the programs at a higher rate than those who do not. HIPs have a positive impact on student performance.

Of the ten types of HIPs endorsed by Kuh and AAC&U [12], six HIPs were employed by the BE-TEC program which are: Capstone Courses and Projects, Writing Intensive Courses, First-Year Experiences, Collaborative Projects, Undergraduate Research, and Internships. Table 1 shows the structure of HIPs within the BE-TEC program. A discussion of the implementation of each HIP and high-impact activity follows Table 1.

Year in bachelor's degree Program	Type of High-Impact Practice (or activity)	Method	Implementation
1st year	First-year course Collaborative project	Curricular Co-curricular	Encouraged - optional Support by BE-TEC
2nd year	Collaborative project	Co-curricular	Support by BE-TEC
3rd year	Collaborative project Internship Undergraduate research	Co-curricular Curricular Co-curricular	Support by BE-TEC Required Required* Encouraged - optional
4th year	Capstone course & project Writing intensive course Undergraduate research	Curricular Curricular Co-curricular	Required, BE-TEC Support Required Encouraged - optional
All years	Faculty mentor Leadership opportunities	Co-curricular Co-curricular	Required for BE-TEC Optional; Encouraged
*Internships changed from a non-credit option to a credit-bearing elective in 2019 to emphasize their importance and encourage participation. Internships are now required for scholarship recipients in UVU's new S-STEM program.			

Table 1: Application of HIPs in UVU's BE-TEC Program

First-Year Experiences

Several first-year experiences were offered to students in the BE-TEC program. Initially, BE-TEC students were encouraged to enroll together in CS 1400 (Object-Oriented Programming), a foundational course required for all majors in the program, with the intent of fostering a sense of community among first-year students. However, varying student schedules made it difficult to place all, or even most, first-year students into a single course section, despite efforts to group as many as possible. As the engineering programs evolved, ECE 1000 (Introduction to Electrical and Computer Engineering) was redesigned to serve as the primary first-year experience. Within this course, ECE scholars in the program were provided with oscilloscope training boards to support hands-on learning through small, introductory projects [13].

Although these courses were not exclusive to students in the BE-TEC program, they provided meaningful high-impact practice (HIP) experiences for BE-TEC students early in their program of study. Faculty serving on the CE/EE curricular design teams included members of the BE-TEC project team and intentionally aligned course design with BE-TEC project goals. Consistent

with the principles outlined in *High-Impact Educational Practices* [10], these first-year experiences brought small groups of students together with faculty on a regular basis and emphasized critical inquiry, information literacy, collaborative learning, and the development of intellectual and practical skills. The HIP characteristics most strongly emphasized included meaningful interactions with faculty and peers on substantive matters, exposure to diverse perspectives, and opportunities to connect learning to real-world applications. In addition, BE-TEC students across all programs used the Computer and Electrical Engineering Laboratory to collaborate on projects, with faculty mentors providing guidance by answering questions, monitoring progress, and directing students to tutoring resources as needed. This program element further illustrates that successful S-STEM initiatives can—and should—be integrated and coordinated with existing departmental and institutional resources [13].

Collaborative Projects

The NSF BE-TEC activities emerged as the strongest community-building component of the program. These activities were intentionally structured to include one collaborative project each semester, hosted by the BE-TEC Club and/or the UVU IEEE Student Section. Although sponsored by BE-TEC, the projects were open to both scholarship and non-scholarship students and were selected to promote collaboration between computing and engineering students. For example, one project involved converting a bicycle into an e-bike equipped with sensors and a user console; another focused on designing a game board; and the current project centers on drone development.

These collaborative projects were multidisciplinary, engaging BE-TEC students from the targeted disciplines as well as students from all academic levels. This structure proved especially beneficial, as upper-division students naturally assumed mentoring roles for first- and second-year students. For instance, a senior BE-TEC student working on a state-sponsored project in fault detection and localization in wind turbines using drones organized a workshop on drone design and programming for students in both departments, utilizing equipment purchased through the BE-TEC program. Overall, these projects were highly effective in fostering a strong sense of community among BE-TEC students and provided valuable high-impact practice (HIP) experiences for students in the middle years of their undergraduate studies [13].

Internships

The BE-TEC program requires all participants to complete an internship course, which is accepted as an elective within the engineering and computing programs. While internship coordination at the university was historically handled within individual schools and colleges, all internships at UVU are now managed through Internship Services in the Office of Engaged Learning (OEL). In 2017, in conjunction with UVU's Title III project, OEL centralized internship coordination to ensure that all internships meet the criteria for a high-impact practice (HIP), thereby promoting consistently high-quality experiences for students across all programs [12].

The Internship Coordinator for the College of Engineering and Technology (CET) maintains a website that outlines internship opportunities for each degree program and provides clear procedures for initiating, completing, and receiving academic credit for an internship. A key component of the internship experience is a six-part Canvas course that requires students to complete a learning agreement with five individualized goals, submit progress reports and a final report, complete student and supervisor surveys, and maintain a log of hours worked (60 hours per credit) [7]. Internship courses are typically overseen by a faculty member from the BE-TEC project team. As designed, these internships incorporate all eight core characteristics of effective HIPs, with strength in connecting learning to real-world applications, requiring sustained student effort over an extended period, and providing structured opportunities for reflection and integration of learning [13].

Capstone Projects

Capstone courses are a central component of the Electrical and Computer Engineering curriculum, serving as a culminating experience in which graduating seniors apply their technical knowledge and professional skills in an integrated design project that prepares them for careers in industry. When the BE-TEC project was initiated, students completed their capstone work in a single-semester course; however, in recent years, UVU—like many engineering programs—has transitioned to a two-semester capstone design sequence. These courses are designed to engage students in applying competencies developed during their first three years of study to the solution of a complex design problem. Through the process of designing, building, and troubleshooting a fully functional system, students find the experience both challenging and highly rewarding, and these projects have proven effective in integrating knowledge and preparing students for the workforce [14].

Capstone projects embody all eight core characteristics of high-impact practices (HIPs), particularly high-performance expectations, sustained investment of time and effort, frequent and constructive feedback, and public demonstration of competence. Traditionally, this public demonstration has taken the form of presentations to faculty and students within the CE/EE or CS/SE departments; more recently, the audience has been expanded to include the CE/EE Advisory Board, industry representatives, and members of the public to broaden outreach and impact. Because capstone projects are a required element of the curriculum, all BE-TEC graduates participated in this high-impact experience. The BE-TEC program further supports capstone work by providing faculty mentoring, project materials, and workshops on essential skills, reducing financial barriers and enabling students to pursue more meaningful design projects. Additionally, BE-TEC funding has enabled students to participate in professional conferences, with faculty mentors providing guidance in preparing papers for publication. To date, twenty BE-TEC scholars have presented their work at various conferences and published in academic journals.

Writing Intensive Courses

The capstone courses at UVU are designated as writing-intensive courses. As part of the university's effort to incorporate more high-impact practices (HIPs) into the curriculum, each department was asked to identify two required courses as Writing Intensive. The Writing Enriched Committee recommended that faculty actively support students' writing development through in-class instruction, guided feedback on plans and drafts, and one-on-one discussions about writing. The HIP characteristics emphasized in these courses complement those of the capstone projects, particularly in fostering "interactions with faculty and peers about substantive matters" and providing "periodic, structured opportunities to reflect and integrate learning." Students in the capstone courses complete weekly low-stakes reports and a comprehensive high-stakes technical report at the end of the semester. They are required to collaborate with tutors from the Writing Center on their final reports and receive feedback from both faculty and peers throughout the process [14].

Undergraduate Research

All BE-TEC students can participate in faculty-mentored undergraduate research activities outside of their capstone project if they choose to do that. For example, a state-funded initiative through the Utah System of Higher Education (USHE) has provided paid mentored research opportunities to three BE-TEC students. These undergraduate research experiences strongly reflected key high-impact practice (HIP) characteristics, including high performance expectations, sustained investment of time and effort, frequent and constructive feedback, and public demonstration of competence, as students collaborated with faculty mentors to prepare conference presentations and papers. Faculty researchers, in coordination with the S-STEM team, are encouraged to intentionally integrate these HIP elements into the design and structure of their undergraduate research projects [14].

Faculty Mentors

While faculty mentors are not formally listed as a high-impact practice (HIP), they are widely recognized as essential to the success of undergraduate STEM programs. Research shows that early and consistent mentorship improves students' transition to college, academic performance, and year-to-year persistence, particularly for women and students from underrepresented groups [13]. A core objective of the BE-TEC program is to provide each participant with a dedicated faculty mentor. Four faculty members have served as mentors, meeting with students each semester—and more often as needed—to provide guidance on academic success, degree progress, career planning, graduate school, and access to tutoring, research, and internship opportunities. The mentor-student relationship reflects key HIP characteristics, including meaningful interactions with faculty on substantive matters and frequent, constructive feedback [14].

Leadership Opportunities within a Professionally Focused Student Organization

Although not formally recognized as a high-impact practice (HIP), leadership roles within the IEEE student chapter or the NSF BE-TEC Club provide a meaningful experiential component of the BE-TEC program. Students serve in positions such as President, Vice President, Social Media Chair, VP of Publications, and VP for University Relations, and under faculty supervision, they plan enrichment and professional development activities, organize workshops, coordinate field trips to local industries, invite guest speakers, and lead collaborative BE-TEC design projects. These leadership experiences foster key HIP characteristics, including substantive interactions with peers and faculty, exposure to diverse perspectives, and opportunities for public demonstration of competence. Participation is optional, and the time commitment varies depending on the role, activity, and student availability.

Major BE-TEC Program Engagement Activities

One of the goals of this program is to increase the retention rate of the students in the computer science and engineering programs by providing engaged learning opportunities, high impact practices, and enrichment activities. The scholarship recipients are participating in interdisciplinary engaged learning opportunities through the BE-TEC club and IEEE student section projects, a required for-credit capstone project, a required internship, and faculty mentored research. Enrichment activities included leadership training and opportunities, two BE-TEC meetings each semester, involvement in student professional organizations or other student service organizations, field trips, Guest Speakers, networking opportunities, and faculty mentoring.

NSF BE-TEC Student Support Services and Programs

The BE-TEC program uses some of the student support services within the College of Engineering & Technology, including academic advising and tutoring for math, writing, engineering, and computer science (supplemented by specialized CE/EE & CS/SE tutors funded by this program). University-wide resources that are used include assistance with employment and admissions to graduate school, and I Am First program for first generation students. In addition, the BE-TEC program is extending or adapting successful evidence-based practices from its Track 1 program. The planned support services and programs have been selected to increase academic learning, completion, and career or graduate school placement, as well as to assist in soft-skills development which is so important for graduates such as communication, teamwork, self-efficacy, leadership, and knowledge integration.

NSF BE-TEC Program Assessment

To assess the four measurable outcomes of our NSF BE-TEC program, a study has been started and conducted by the institution's Business Intelligence and Research Services to compare the NSF BE-TEC students to a comparison group. The comparison group is formed by matching the NSF BE-TEC scholars with nonrecipients who are also attending during the first semester they received the scholarship. The comparison group is randomized and then matched by major, gender, age, class level (credit hours completed), first generation status, and race/ethnicity. In addition to forming a comparison group, a telephony survey of BE-TEC participants is conducted every year. Another telephony survey is conducted after a student graduates. Table 1

shows the result of the comparison between S-STEM recipients and a comparison group as of July 2025.

Table 1: Comparison between BE-TEC Recipients and a Comparison Group as of July 2025		
	BE-TEC Participants	Comparison Group *
Total # of students	55	55
First-generation student	15	13
Positive Student Outcomes		
Graduated with BS STEM degree	37 (67.3%)	26 (47.3%)
Graduated with BS in non-STEM major	2 (3.6%)	3 (5.5%)
Transferred with AS STEM degree	0	0
STEM major retention rate. **Note.** This retention rate excludes all students from each category who have received a BS degree in any major.	75.0% (12 of 16) Note. 55-39 (BS graduates) =16	57.7% (15 of 26) Note. 55-29 (BS graduates) =26
Negative Student Outcomes		
Changed to Non-STEM	2	5
Left school without BS degree	4	10
Transferred without AS degree	0	0
Student Success Predictors		
GPA Averages	3.66	3.49
Semesters to Graduation	11.9	13.0
*The comparison group: BE-TEC participants were matched with non-recipients who attended during the same semester award was received. The comparison group was randomized and then matched by major, gender, cumulative credits completed, and race/ethnicity by a qualified researcher in Institutional Engagement and Effectiveness. *Sources:* PI records & UVU's Office of Data Collection and Research.		

BE-TEC's measurable Objective A is **Graduation.** A minimum of 20 scholarship recipients will graduate with a baccalaureate degree in EE, CE, CS, or SE by the end of year six.

Target: Students in the BE-TEC program will graduate at a higher rate than their peers in the targeted programs.

Method: A comparison group was created by a Senior Research Analyst from UVU's Office of Data Collection and Research during the summer of 2025. The Senior Research Analyst created the comparison group by matching BE-TEC scholarship recipients, i.e., the treatment group, with non-scholarship recipients in the same majors who attended during the same first semester as BE-TEC scholarship recipients. The selection of the comparison group was randomized and then matched by gender, class level, and race/ethnicity.

Report: As of July 31, 2025, there have been 55 unique students who have been awarded BE-TEC scholarships. Of these 55 students, 37 have received their BS degrees in BE-TEC approved majors. This number of BE-TEC graduates (37) is only one below the target number of 38, and there are still two more years in the current grant cycle.

BE-TEC's measurable Objective B is **Completion and year-to-year persistence.**

Target: Thirty-eight scholars will persist or graduate in STEM (88%).

Method: Track the persistence rate in STEM degree programs of BE-TEC students verses the comparison groups.

The table 1 indicates by the end of the fourth year, BE-TEC scholarship recipients graduated with BS STEM degrees at a higher rate than non-scholarship recipients in the same majors (comparison group) at 67.3% STEM graduation rate vs. 47.3% STEM graduation rate. More BE-TEC students were retained in their STEM majors than the comparison group. The fall-to-fall semester STEM retention rate for BE-TEC students versus the comparison group was: 75.0% versus 57.7%.

It should be noted that currently there are 15 first-generation students among the 55 BE-TEC students (27.3%). Both comparison groups were matched closely with the BE-TEC treatment group. The comparison group had 13 first-generation students (23.7%). As of 2022 data, UVU's percentage of first-generation students is 37.0%. Because first-generation students typically struggle at UVU, it will be valuable to track this group of BE-TEC students in subsequent years with the group of first-generation students in the comparison group.

BE-TEC's measurable Objective C is **Employment in STEM Workforce**. A minimum of 95% of BS degree graduates will be employed in a STEM field or enrolled in graduate school within in 6 months after graduation.

Method: During June 2025, the "BE-TEC Graduates' Survey" was administered via telephone under the guidance and direction of the Supervisor of Survey Research of UVU's Office of Institutional Engagement & Effectiveness to BE-TEC students who had recently graduated with their Bachelor of Science (BS) degrees in BE-TEC majors. There were 39 BE-TEC graduates in this group, and 20 of these recent graduates responded to this BE-TEC Graduates' Survey for a response rate of **51.3%**.

Target: 95% of graduates will be employed or in graduate school.

Report: By the end of the fourth year of this six-year BE-TEC project, 39 BE-TEC students have graduated with their BS degrees. 37 of 39 (94.9%) have graduated with BS degrees in BE-TEC approved majors.

During June 2025, the BE-TEC Graduates' Survey was offered to all 39 of these graduates. 20 of 39 (51.3%) responded to this survey (a copy of the survey is given in appendix A).

In response to the question: **Are you currently enrolled in graduate school?**

Of these 20 survey respondents, 17 (85.0%) responded that they were not currently enrolled in graduate school; 3 (15.0%) responded that they were currently enrolled in graduate school.

In response to the question: **Are you currently employed or hired for a position you have not started yet?**

Of the 20 BE-TEC graduates who responded to this survey, all 20 (100.0%) provided a "YES" response to this question.

In response to the question: Is your job in Electrical Engineering, Computer Engineering, Computer Science, Software Engineering, or some related science, mathematics, technology, or engineering related field?

All 20 survey respondents provided a response to this question. 19 of 20 (95.0%) respondents answered "YES"; 1 of 20 (5.0%) answered "NO" to this question.

In conclusion as regards to objective C: the results of the 2025 "BE-TEC Graduates" Survey indicate that 100% of BS degree graduates are employed in a STEM field and/or enrolled in graduate school within six months after graduation.

BE-TEC's measurable Objective D is **Advance Knowledge.** Scholars will show advanced knowledge about the use of internships to learn relevant job skills, increase social and communication skills, and improve employment outcomes (salary & jobs in field). Two papers on the results of the program will be submitted and presented at conferences.

Method: Information about scholars advanced knowledge in the use of internships to learn relevant job skills, increase social and communication skills, and improve employment outcomes (salary & jobs in field) will be gathered during the six-year cycle of this program through a variety of means such as: a) personal interviews, b) phone interviews, c) capstone projects, etc. This information will be published in two papers on the results of this BE-TEC program before the end of the project. These papers will be presented at conferences.

Report: Last year the PI of this BE-TEC project had a paper published on the results so far of this BE-TEC project. She has plans to write and publish at least one more paper on the results of this project before the end of project year 6, i.e., July 31, 2027.

As evidence of progress toward Objective D: Advanced Knowledge, twenty NSF BE-TEC scholars have engaged in research across various areas, resulting in the following scholarly outputs:

- 19 abstract presentations of capstone and research results
- 4 journal publications
- 9 conference publications and presentations

NSF BE-TEC Scholarship Report

Fifty-five NSF BE-TEC scholars in six different STEM programs at UVU have participated in the NSF BE-TEC program up to now. Table 2 lists students from different programs that participated in the NSF BE-TEC program.

Programs	NSF Scholars
Computer Engineering	6
Computer Science	19
Software Engineering	10
Electrical Engineering	18
Computational Data Science	3
Software Development	2
Total	55

Table 2: Number of Scholars from Different Programs

Scholarships were first awarded in January 2022. A total of 55 students has received scholarships. Since the beginning of this BE-TEC program on August 1, 2021, **14** BE-TEC students have received their B.S. degrees in Computer Science; **10** in Electrical Engineering; **6** in Software Engineering; **3** in Computer Engineering; and **2** in Computational Data Science; **2** in Software Development. This equates to a BE STEM degree graduation rate of **67.3%**. The BE STEM degree graduation rate for Comparison Group, i.e., students is currently **47.3%**.

The fall-to-fall semester STEM retention rate for the BE-TEC students is **75.0%**. This compares to a STEM retention rate of **57.7%** for the comparison group. The cumulative GPA for the BE-TEC scholars are **3.66 GPA**. The cumulative GPA for Comparison Group is **3.49 GPA**. Lastly, BE-TEC scholars are averaging **11.9 semesters** to obtain their BS degrees. Conversely, comparison group students are averaging **13.0 semesters** to obtain their BS degrees.

Impacts of the NSF BE-TEC Program

Degree Completion

The state of Utah has such a critical shortage of engineers and computer scientist that it has sustained a "Engineering and Computer Science Initiative" since 2011. The BE-TEC program has contributed to meeting the goals of this initiative by graduating 37 students up to now. Since the beginning of this BE-TEC program on August 1, 2021, **14** BE-TEC students have received their B.S. degrees in Computer Science; **10** in Electrical Engineering; **6** in Software Engineering; **3** in Computer Engineering; and **2** in Computational Data Science; **2** in Software Development. The BE-TEC program has made it possible for students who work to support their families to remain in school and complete their degrees, making them more valuable human resources for the companies that employ them.

Career Preparation

BE-TEC participants have reported through yearly surveys of the BE-TEC program directly assisted them in obtaining employment in their field. They report that activities such as career speakers and field trips to companies helped them network with employers and land good

jobs. BE-TEC club and IEEE student section activities have provided valuable leadership opportunities and taught students useful job skills through hand-on workshops. All BE-TEC students who have graduated have completed a capstone project, which is a significant factor in the hiring process. Several students have conducted faculty-mentored research and have given presentations at conferences. Moreover, the faculty mentoring program has also been helpful in developing human resources, particularly in helping students complete their degree programs with an eye toward employment.

The financial benefits to students who are receiving the NSF BE-TEC scholarships are tremendous: the scholarships help students attend school, focus on their schoolwork, get better grades, complete their degrees, and complete them more quickly. The benefits of the BE-TEC projects support activities were also invaluable to students in retaining them in the program and better preparing them for their careers or continued education. The leadership and internship experience that they get in this program is very helpful in finding better paying jobs and preparing them for job interviews. Overall, this program provides an excellent opportunity for students in the engineering and computing programs toward a successful graduation on time.

The Utah System of Higher Education and the Utah Governor's office report that regional economic prosperity is directly linked to individual and collective educational achievement. As education levels increase, individual earning potential also increases, unemployment decreases, and contribution to the tax base increases. Much evidence also shows that in a knowledge-based economy, a higher level of education among the population stimulates economic growth. In addition, there are social benefits directly tied to education that have impact on both the economy and other aspects of the quality of life in Utah. Benefits of higher education described by the Education Pays report include: a healthier lifestyle, reduced costs of healthcare, increased job satisfaction, increased civic involvement, and increased engagement in educational activities with their children, and increased college attendance of their children, among other things. Thus, by increasing the graduation rate for BE-TEC participants and facilitating the graduation of students, the program has and will impact on the regional society as well as individual graduates and their families.

Conclusion

This paper is a presentation of the progress report of UVU's BE-TEC program which is an NSF supported S-STEM project whose goal is to enable academically talented and financially needy students to pursue college degrees in computing sciences and engineering. This program, now in its fifth year, is increasing the graduation rate for students in Computer Science and Engineering at Utah Valley University, an open enrollment university, and better preparing them for continued education and/or success in the STEM workforce by providing scholarships to academically talented students with financial need and by providing leadership opportunities, engaged learning activities, and mentoring. Overall, the BE-TEC program is an effective tool in helping to recruit, retain, and promote computer science and engineering programs.

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